
The Similarity of European Union Countries in Terms of the Structure of the Unemployed

Submitted 11/07/20, 1st revision 17/08/20, 2nd revision 18/09/20, accepted 22/10/20

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Abstract:

Purpose: The purpose of this work is to assess the degree of similarity in the structure of the unemployed according to various categories (gender, age, education, the duration of unemployment) in the EU countries.

Approach/Methodology/Design: As a research tool, the vector elimination method was used, which facilitates a division of a set of objects into subgroups with similar structures. Statistical data on the structure of the unemployed due to selected features in 28 European Union countries come from the Eurostat database and relate to 2018.

Findings: The spatial distribution of groups of EU countries in 2018 confirms the authors' observations formulated at the beginning of the work that the structures of the unemployed by selected categories are similar in most countries, but it is also possible to distinguish countries in which these structures are significantly different.

Practical Implications: The knowledge about the regularities of the structures of the unemployed in individual EU countries is necessary when developing strategies to combat unemployment, especially among people in a particular situation on the labor market.

Originality/Value: There are no comprehensive analyzes in the literature to determine the similarity of the structure of the unemployed in EU countries, taking into account various demographic features that are typically taken into account in this type of research (e.g., gender, age, or level of education). The presented studies fill a gap in this area, they can also complement existing studies focusing mainly on the level of unemployment.

Keywords: Structure of the unemployed, similarity of structures, Vector Elimination Method, European Union countries.

JEL classification: C8, F5, J21

Paper types: Research study.

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1. Introduction

Unemployment is a multi-thread phenomenon, mainly affecting all major spheres of political, economic, and social life. It affects many millions of people around the world, threatens various states and ages, especially women and young people. The results of many studies presented so far have confirmed, among others the relationship between unemployment and poor health, especially mental health, as well as relationships with harmful health behaviors such as smoking and drinking problems (Nordenmark and Strandh, 1999; Winkelmann, 2009; Hammarström *et al.*, 2011; Virtanen *et al.*, 2013; Hiswåls *et al.*, 2017; Dmytrów and Bieszk-Stolorz, 2019).

Unemployment significantly reduces the level of satisfaction of an individual with his main professional activities and finances (Ahn *et al.*, 2004). It also involves numerous costs for the state budget, the unemployed, and the whole society (Lorenčič, 2013). Research shows that up to 15 years later, the wages and career advancement of college graduates who enter the labor market in times of economic downturn remain lower than employees who enter the market when the economy is strong. Numerous studies also suggest that high unemployment is directly related to the increase in crime (Winter-Ebmer, 2001; Melick, 2003; Land and Philips, 2012; Entorf and Sieger, 2014; Bąk, 2015). According to some researchers, as the duration of unemployment increases, personal and social costs: including financial difficulties, debt and poverty, homelessness, stress, tension and family breakup, boredom, alienation, shame and stigma, increased social isolation, crime, disappearance professional skills, and poor health, increase (Dixon, 1992; White, 1991; VSJCC, 1992).

The results of many studies also show that many demographic and social features describing the structure of the unemployed contribute to a higher risk of unemployment. These features include, among others: sex, age, education, or time spent without work. The knowledge of this information in spatial terms allows, *inter alia*, to distinguish those areas in which the unemployed dominate in a particular situation on the labor market. Much space was devoted to cross-sectional studies presenting the phenomenon of unemployment, taking into account the structure of the unemployed. Only in the last five years in the Web of Science database have over 100 papers been identified, in which one can find, in various forms, references to determine *the structure of unemployment*. Popp (2017) writes about the structure of the potential unemployed in the context of its impact on the amount of possible unemployment insurance. Topgul (2016) presents the structure of the unemployed in the context of its impact on the worrying changes in the labor market associated with the aging of the population. Zieliński (2015) examines the relations between the economic crisis, the level and structure of unemployment (taking into account the situation of women and young people as the groups strongly exposed to unemployment), and the level and structure of expenditures within the labor market policy. Studies presented by Pozega *et al.* (2013) are focused on analyzing changes in the structure of the unemployed due to their level of education.

Among the numerous publications dealing with the problem of the structure of the unemployed, the authors of this work identified only one (Gordon and Klopov, 2000), which discussed this structure in terms of spatial similarity. However, this study only concerned one country. It focused on assessing the similarity of the impact of material and social conditions on the degree of marginalization of various groups of the unemployed (e.g., women and men, people with vocational and higher education, etc.). In the subject literature, there is no comprehensive research to determine the similarity of the structure of the unemployed for example in the EU countries, taking into account various demographic features that are typically taken into account in this type of study (e.g., gender, age, level of education, or the time of being unemployed). The identified research gap in this area prompted the authors to research this area.

The purpose of the work is to assess the degree of similarity in the structure of the unemployed according to various categories (gender, age, education, the duration of unemployment) in the EU countries. The current studies of various authors and official statistics data show that in the EU countries the structure of the unemployed does not differ significantly due to the categories indicated, i.e., among the unemployed prevail men⁵, people entering the labor market and aged 50+, with lower education level and those unemployed for over 12 months (Lewandowska-Gwarda, 2018). According to the authors, these regularities might be observed in most EU countries. However, due to the significant diversity of various phenomena (e.g., level and quality of life, innovation, competitiveness, entrepreneurship, etc.), a more detailed analysis is needed. For this purpose, the authors grouped EU countries due to the similarity of the unemployed structures based on statistical data on unemployment at the end of 2018. The method of vector elimination was used for grouping.

2. Research Methodology

The method of vector elimination was proposed by Chomorkski and Sokołowski (1978) as a tool enabling periodization of the examined period due to the structural similarity of the analyzed objects. This method can also be used to divide a set of objects into subgroups of objects with similar structures. The use of this method to group objects with similar structures can be found, among others in papers by Nowak, (1990), Młodak (2006), Wawrzyniak (2012), and a comprehensive review of various taxonomic methods that can be used to study the similarity of structures in regional terms is found in Strahl (1998; 2006). An intriguing proposal to study the dynamics of structures can be found in the paper by Kukuła, (1975). However, the paper by Wędrowska (2012) presents an overview of various measures that can be used in the analysis of structures. The research on the similarity of structures relating to European Union countries can also be found in the works of Malina (2006; 2008).

The application of the vector elimination method requires that the examined objects (e.g., countries) are described through features that constitute a structure formed on

⁵*Women register as unemployed less often than men.*

the basis of a uniform qualitative or quantitative criterion. According to Młodak (2006) such a set of features

$$\mathbf{X} = (X_1, X_2, \dots, X_m) \quad (1)$$

we call a structural set when two conditions are met simultaneously:

- 1) normalization condition, i.e. $x_{ij} \in [0; 1]$,
- 2) unit sum condition, i.e.

$$\sum_{j=1}^m x_{ij} = 1 \quad (2)$$

where:

x_{ij} - the share of the j -th feature in the structure of the i -th object, $i = 1, 2, \dots, n$, $j = 1, 2, \dots, m$, n - the number of objects, m - the number of features in the structural set.

Shares x_{ij} are presented in a matrix with dimensions $n \times m$, which can be written as follows (the symbols used are the same as in formula 2):

$$[x_{ij}] = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1m} \\ x_{21} & x_{22} & \dots & x_{2m} \\ \dots & \dots & \dots & \dots \\ x_{n1} & x_{n2} & \dots & x_{nm} \end{bmatrix} \quad (3)$$

The share matrix $[x_{ij}]$ is the starting point for determining the distance matrix of the structures of the form:

$$\mathbf{P} = [d_{ik}] = \begin{bmatrix} d_{11} & d_{12} & \dots & d_{1n} \\ d_{21} & d_{22} & \dots & d_{2n} \\ \dots & \dots & \dots & \dots \\ d_{n1} & d_{n2} & \dots & d_{nn} \end{bmatrix} \quad (4)$$

where d_{ik} is the distance between the structure of the i -th and the k -th object ($i, k = 1, 2, \dots, n$).

Matrix \mathbf{P} is a square matrix ($n \times n$) and symmetrical ($d_{ik} = d_{ki}$). When creating the matrix \mathbf{P} , one should decide on the method of measuring the distance between the structures of the examined objects. Various proposals for determining these distances can be found in the literature (Kukuła, 1975, 1986; Chomątowski and Sokołowski, 1978; Rutkowski, 1981; Walesiak, 1984, 2016; Roeske-Słomka, 1998; Młodak, 2006; Wędrowska, 2012). The article decided on the median distance of structures calculated according to the formula (Młodak, 2006):

$$d_{ik} = \text{med}_{j=1,2,\dots,m} |x_{ij} - x_{kj}| \quad (5)$$

where: x_{ij} - the share of the j -th features in the structure of the i -th object, x_{kj} - the share of the j -th feature in the structure of the k -th object, med - median calculated on

absolute differences between the shares of the j -th feature in the structure of the i -th and k -th object, d_{ik} - the distance between structures of the i -th and k -th object, $i, k = 1, 2, \dots, n$, $j = 1, 2, \dots, m$, n - the number of objects, m - the number of features in the structural set. The determined distances are normalized in the range $[0; 1]$. If $d_{ik} = 0$ the structures in the i -th and k -th object are identical. However, the closer the value of d_{ik} is to 1, the more significant the difference in structures in the i -th and k -th object.

The structure distance matrix \mathbf{P} is the starting point for grouping objects using the vector elimination method, which is implemented in the following stages:

- 1) we convert the matrix into the zero-one matrix $\mathbf{P}_1 = [d_{1.ik}]$ according to the principle: if $d_{ik} < \alpha$, then $d_{1.ik} = 0$, if $d_{ik} \geq \alpha$, then $d_{1.ik} = 1$, where α is an arbitrarily accepted critical level of lack of similarity between the two structures,
- 2) based on the matrix \mathbf{P}_1 , we create the column vector \mathbf{p}_0 with n components, and each component is the sum of the corresponding row of this matrix,
- 3) from the matrix \mathbf{P}_1 we eliminate this row and the corresponding column for which the component value of the vector \mathbf{p}_0 is maximum; in the case when more than one component of the vector \mathbf{p}_0 is equal to the maximum value, an auxiliary criterion can be used to select the row and column eliminated in a given step,
- 4) Repeat the operations described in points 2 and 3 until all components of the vector \mathbf{p}_0 are equal to 0,
- 5) objects that remain in matrix \mathbf{P}_1 form the first subgroup,
- 6) for objects that have been eliminated, we create a stripped matrix \mathbf{P} by removing those rows and columns that correspond to the objects classified to the first subgroup and follow the procedure presented in points 1-5,
- 7) the procedure is finished when all objects are grouped.

Because the article uses the median distance proposed by Młodak (2006) to measure the distance between structures, the critical level α as determined according to the formula: $\alpha = \min_{i=1,2,\dots,n} \max_{k=1,2,\dots,n} d_{ik}$ and the auxiliary criterion was the principle of maximizing the median distance of these rows of the \mathbf{P} matrix, which corresponds to equal maximum values of the vector components \mathbf{p}_0 .

3. Research Results

Following the purpose of the study, the similarity of the European Union countries was assessed in terms of the structure of the unemployed by sex, age, education and duration of unemployment. Statistical data on the structure of the unemployed due to selected features in 28 European Union countries come from the Eurostat database and relate to 2018. The vector elimination method enabled the grouping of EU

countries according to the degree of similarity of the structure of the unemployed by selected categories. The results of the grouping are presented in Table 1.

Table 1. Division of EU countries into groups characterized by similarity in the structure of the unemployed by selected demographic features

Group	Gender	Age	Educational level	Duration of unemployment
1	n = 22 Austria, Belgium, Croatia, Cyprus, Denmark, Estonia, Finland, France, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Slovenia, Slovakia, Spain, Sweden, United Kingdom	n = 18 Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Estonia, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Portugal, Slovakia, Spain, Romania	n = 16 Austria, Belgium, Bulgaria, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Latvia, Netherlands, Slovakia, Romania, United Kingdom	n = 20 Austria, Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Germany, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovenia, Spain, Sweden, United Kingdom
2	n = 4 Bulgaria, Germany, Malta, Romania	n = 6 Denmark, Finland, Malta, Poland, Sweden, United Kingdom	n = 6 Denmark, Italy, Luxembourg, Portugal, Spain, Sweden	n = 6 Belgium, Bulgaria, Greece, Italy, Romania, Slovakia
3	n = 2 Czech Republic, Greece	n = 2 Lithuania, Slovenia	n = 5 Croatia, Cyprus, Lithuania, Poland, Slovenia	Denmark
4		Croatia	Malta	Poland
5		Netherlands		

Source: Own calculations.

Below there is the conducted analysis of the average shares of the unemployed by selected demographic features in similarity groups of EU countries. The information presented in Table 2 shows that in the first, most numerous group, the number of unemployed men is slightly higher than that of women. In the second group, unemployment was distinctively higher for men than for women. In turn, in the third group of countries, to which only two countries belong (the Czech Republic and Greece), the dominance of unemployed women over men is noticeable. Due to the

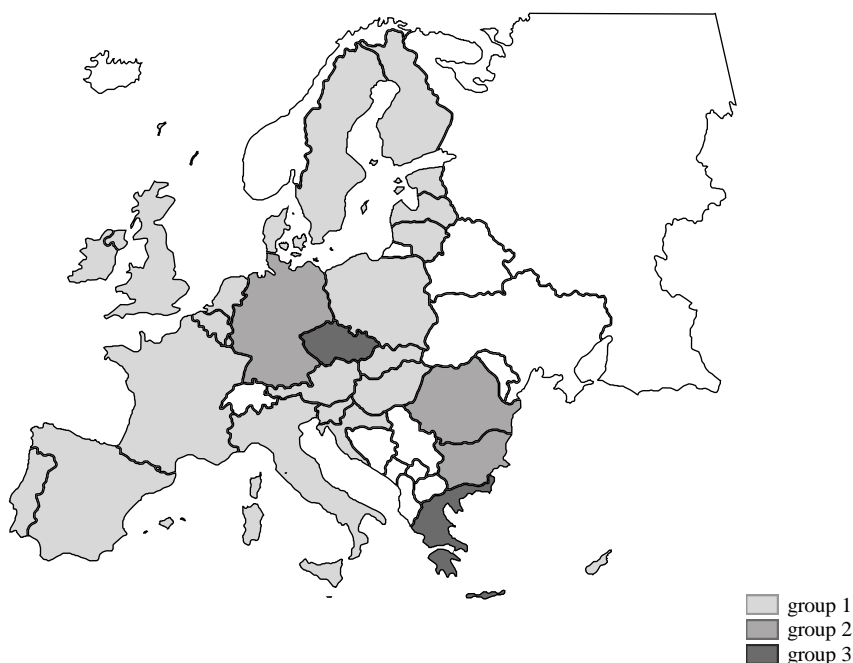
distribution of groups of countries, it is difficult to indicate geographical connections (Figure 1).

Table 2. Average shares of the unemployed by gender in similarity groups of EU countries

Group	Male	Female
1	0.522	0.478
2	0.610	0.390
3	0.444	0.556

Source: Own elaboration.

Figure 1. Spatial distribution of groups of EU countries by the similarity of the structure of the unemployed by gender in 2018



Source: Own elaboration.

The analysis of the information contained in Table 3 shows that in groups 1 and 3 the most numerous group of unemployed were young people aged 20-24 - their average share in these groups of countries were respectively: 13.6% and 15.5%. In group 2, a higher percentage of the unemployed occurred in the age group of 25-29 years. In turn in group 4 this share was the highest for the group of 30-34 years old. An in-depth analysis also indicates the diversity of groups of countries in terms of the number of young unemployed people (up to 34 years old). The lowest share of this age category was recorded for group 1 (45.4%), while the highest for group 4 (58.7%). The opposite

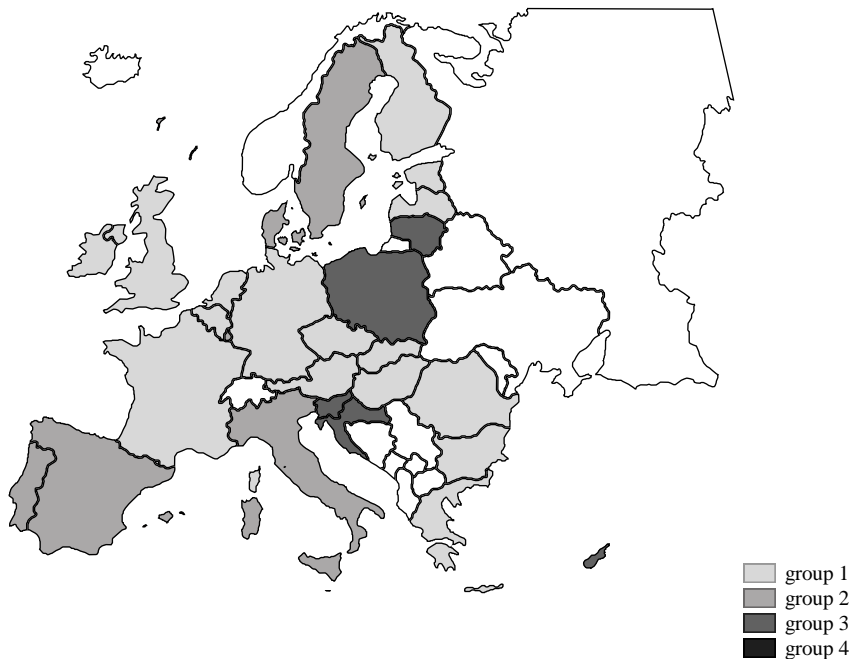
situation is observed for the unemployed aged 50 and more, the share of this age category in group 1 is the highest (24.0%) and the lowest in group 4 (17.9%). The spatial distribution of groups of EU countries according to the degree of similarity of the structure of the unemployed by age in 2018 is presented in Figure 2.

Table 3. Average shares of the unemployed by age in similarity groups of EU countries

Group	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60 and more
1	0.072	0.136	0.131	0.115	0.109	0.099	0.098	0.092	0.089	0.058
2	0.085	0.140	0.149	0.113	0.104	0.106	0.092	0.091	0.075	0.045
3	0.033	0.155	0.154	0.131	0.117	0.100	0.090	0.087	0.092	0.041
4	0.133	0.166	0.111	0.177	0.067	0.067	0.100	0.056	0.056	0.067

Source: Own elaboration.

Figure 2. Spatial distribution of groups of EU countries according to the degree of similarity of the structure of the unemployed by age in 2018



Source: Own elaboration.

In all isolated groups of similarities, the highest average share concerned the unemployed with Levels 3–4 education (Table 4), with the highest for group 4 (67.7%) and the lowest for group 5 (39.5%). Regarding the remaining categories of education,

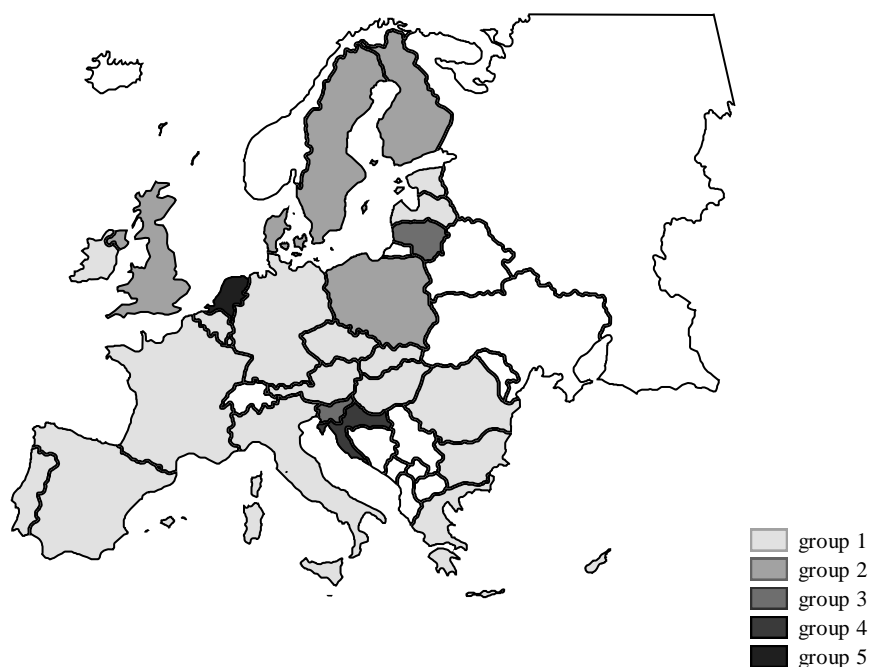
it was in the countries of groups 3 and 4 where the unemployed with higher education dominated over people with the lowest education, while in the remaining groups this relation is reversed. The spatial distribution of groups of EU countries according to the degree of similarity of the structure of the unemployed by level of education in 2018 is presented in Figure 3.

Table 4. The average share of the unemployed by education level and similarity groups in the EU countries

Group	Levels 0-2	Levels 3-4	Levels 5-8
1	0.307	0.478	0.215
2	0.327	0.446	0.227
3	0.137	0.641	0.222
4	0.119	0.677	0.204
5	0.364	0.395	0.241

Source: Own elaboration.

Figure 3. Spatial distribution of groups of EU countries according to the degree of similarity of the structure of the unemployed by level of education in 2018



Source: Own elaboration.

The separated similarity groups evidently differ in terms of the distribution of duration of unemployment (Table 5). For groups 1 and 3, most people were out of work for 1 to 2 months, followed by 3 to 5 months. In group 2, the highest share was recorded in

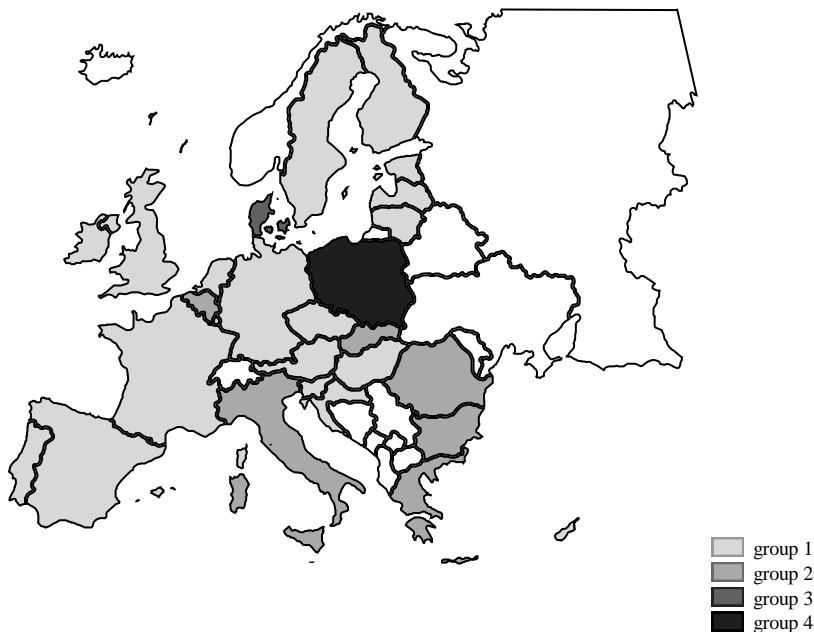
the range of 48 and more months, which may indicate the occurrence of long-term unemployment. The unemployed in group 4 usually remained unemployed for 3 to 5 months. The spatial distribution of groups of EU countries according to the degree of similarity of the structure of the unemployed by the duration of unemployment in 2018 is presented in Figure 4.

Table 5. *Structure of the unemployed by the duration of unemployment and similarity groups*

Group	Less than 1	1–2	3–5	6–11	12–17	18–23	24–47	48 or over
1	0.119	0.202	0.175	0.161	0.100	0.045	0.096	0.101
2	0.052	0.112	0.122	0.139	0.136	0.064	0.168	0.206
3	0.183	0.252	0.211	0.153	0.085	0.036	0.042	0.038
4	0.180	0.149	0.219	0.183	0.120	0.042	0.075	0.032

Source: Own elaboration.

Figure 4. *Spatial distribution of groups of EU countries according to the degree of similarity of the structure of the unemployed by the duration of unemployment in 2018*



Source: Own elaboration.

4. Summary and Discussion

The spatial distribution of groups of EU countries due to similarities of the analyzed unemployment structures in 2018 confirms the authors' observations formulated at the

beginning of the paper that the structures of the unemployed by selected categories are similar in most countries. However, it is also possible to distinguish countries in which these structures are significantly different. The research shows that for each analyzed category (gender, age, education and duration of unemployment), the first group was most numerous, comprising from 16 countries due to the structure of the unemployed according to education level to 22 countries due to the structure in terms of sex. The separation of other groups indicates that there are some differences, which may result from the specific conditions of the labor markets of individual countries, including e.g. legal regulations. The structure of the unemployed, mainly in the southern European countries, could also be affected by the situation related to the immigration crisis. In countries such as Italy, Greece, Spain in the analyzed period had a high unemployment rate. At the same time, the results obtained indicate a high proportion of people with a lower level of education (see Table 4). People from these countries were usually longer out of work (over 48 months).

When analyzing individual groups of similarities, it is worth paying attention to countries which, for the majority of the examined categories (three), were assigned to less numerous or even one-element groups. They include:

- Malta - has been separated individually in terms of the structure of the unemployed due to the level of education. The country has the highest share of the unemployed with education at levels 0-2; besides, it was in group 2 together with Bulgaria, Germany and Romania regarding the high proportion of unemployed women, as well as in a separate group (together with five countries) by age.
- Denmark - created a one-element group due to the structure of the unemployed regarding the duration of unemployment. The highest shares relate to the unemployed, who remain unemployed for up to 12 months. Also, it was highlighted in separate groups (together with five countries) due to age and level of education.
- Poland - qualified to the one-element group regarding the duration of unemployment - a share of several percent applies to the unemployed who remain unemployed for up to 17 months. The country has the highest share of the unemployed with education at levels 3-4, and therefore it is in a separate group together with four countries in which this share is also high. In terms of the age of the unemployed, Poland was also included in a smaller group (together with Denmark, Malta, Finland, Sweden and the United Kingdom).
- the Netherlands - created a one-element group in only one category, it has similar shares of the unemployed due to two levels of education: levels 0-2 and levels 3-4; in the case of the remaining criteria, the country was in the first, most numerous group.

It is also worth emphasizing that research focused on analyzing the dependence of the level and structure of unemployment and various types of factors essential for the development of European Union countries may complement the results of the research

presented in this paper. The studies of similar scope have already been described in the literature. Fagerberg *et al.* (1997) claim, for example, that differences in the level of unemployment of European Union countries may result from the level of GDP achieved *per capita*, innovation and technological advancement. Gallie (2013) points out that despite the similarity of EU countries due to the level of unemployment achieved, the consequences of this phenomenon differ from one society to another. Perugini and Signorelli (2010) analyzes in his work the convergence between the unemployment level variability and the structure of economic specialization in the EU countries.

According to the authors, this type of research should, however, focus not only on the level of unemployment, but also on its structure taking into account, for example, gender, age, and duration of unemployment. This type of research can be a continuation of the analyzes presented in the paper.

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